Table 1: Mopaliidae

Location	Date	♀	♂	Gamete Shedding Time Start	Gamete Shedding Time Finish	Tide Next High	Tide Next Low	Note
Mopalia ciliata (SOWERBY, 1840)								
South Side, Pigeon Point[3]	30 Nov. 1956	1		2230	2330	2220	0250	
South Side, Pigeon Point[3]	30 Nov. 1956		1	2320	2430	2220	0250	
North Side, San Pedro Point[3]	25 Feb. 1957		1	2000	2030	2130	0235	
North Side, San Pedro Point[3]	25 Feb. 1957	1		2100	2215	2130	0235	
North Side, San Pedro Point[3]	25 Feb. 1957		1	2130	2220	2130	0235	
North Side, San Pedro Point[3]	27 Feb. 1957	2		2200	0100	2235	0400	1
Pescadero Point[1]	21 Mar. 1957		1	1815	1900	1600	2030	2
Sausalito[1]	25 Sep. 1957		1	0230	?	0225	0726	3, 4
Sausalito[1]	22 Oct. 1957		1	2100	?	2335	0430	3, 4
Sausalito[1]	22 Oct. 1957	1		2245	?	2335	0430	3, 4
North Side, San Pedro Point[3]	25 Oct. 1957	1		2400	0200	0130	0615	3, 4
Mission Point[1]	21 Feb. 1960	1		2100?	2200	1915	2400	5
Franklin Point[3]	22 Feb. 1960		1	2130	2200	2015	0110	6
Franklin Point[3]	27 Feb. 1960		1	2330	2430	2340	0530	
Tiburon[1]	20 Nov. 1960	1		2130?	2345	0200	0645	
Tomales Bay[1]	11 Mar. 1961	1		1900?	2130	2100	0130	5
Tomales Bay[1]	11 Mar. 1961		1	1900?	2130	2100	0130	5, 6
Tomales Bay[1]	11 Mar. 1961		1	2030	2200	2100	0130	6
Aquatic Park, San Francisco[2]	15 July 1961		1	1530	1640	1530	2020	
Mopalia, spec. nov.								
Marina, San Francisco[2]	30 Apr. 1961		1	1130?	1400	1300	1815	5
Marina, San Francisco[2]	13 May 1961		1	1530	1700	1215	1735	
Marina, San Francisco[2]	13 May 1961	2		1800	1915	1215	1735	
Marina, San Francisco[2]	13 May 1961		2	1800	1915	1215	1735	
Marina, San Francisco[2]	13 May 1961	1		1900	2010	1215	1735	
Marina, San Francisco[2]	14 May 1961		1	1200	1215	1310	1815	
Marina, San Francisco[2]	14 May 1961	1		1900	2010	1310	1815	
Aquatic Park, San Francisco[2]	15 July 1961	2		1930	2200	1530	2020	
Aquatic Park, San Francisco[2]	15 July 1961		1	1930	2200	1530	2020	
Aquatic Park, San Francisco[2]	15 July 1961	1		2230	2300	1530	2020	
Aquatic Park, San Francisco[2]	15 July 1961		1	2200	2300	1530	2020	
Mopalia lowei (PILSBRY, 1918)								
Tomales Bay[1]	11 Mar. 1961		1	2100	2200	2100	0130	6
Tomales Bay[1]	3 June 1961	1		1600	1730	1740	2240	4 a
Mopalia porifera (PILSBRY, 1892)								
Pescadero Point[3]	10 Nov. 1958	2		2130	2200	2230	0330	
Pescadero Point[3]	10 Nov. 1958		2	2145	2300?	2230	0330	8
Pescadero Point[3]	10 Nov. 1958		3?	2200?	2400	2230	0330	8
Pescadero Point[3]	5 Mar. 1959	1		2425	2450	2050	0205	
Pescadero Point[3]	5 Mar. 1959	1		0125	0210	2050	0205	
Pescadero Point[3]	5 Mar. 1959		1	2345	2415	2050	0205	
Pescadero Point[3]	14 Oct. 1961		1	2400	2425	0315	0740	
Pescadero Point[3]	14 Oct. 1961		1	2430	0100	0315	0740	
Pescadero Point[3]	14 Oct. 1961	1		2445	0105	0315	0740	
Pescadero Point[4]	14 Oct. 1961		1	0105	?	0315	0740	13
Pescadero Point[4]	14 Oct. 1961	1		?	?	0315	0740	7, 14
Franklin Point[4]	12 Mar. 1960	2		2230?	2320	2235	0420	5

[1] = Marin County [2] = San Francisco County [3] = San Mateo County
[4] = Monterey County [5] = Los Angeles County

Table 1: Mopaliidae (continued)

Location	Date	♀	♂	Gamete Shedding		Tide		Note
				Time Start	Time Finish	Next High	Next Low	
Mopalia hindsi (Reeve, 1847)								
San Pedro Point[3]	25 Oct. 1957	1		?	2345	0130	0615	3, 4, 6
Moss Beach[3]	28 Oct. 1957	1		9 a	9 a	0315	0730	3, 4, 7
Mopalia imporcata (Carpenter in Pilsbry, 1892)								
Franklin Point[3]	26 Feb. 1961	1		1840	2000	2120	0220	4 b
Franklin Point[3]	26 Feb. 1961	1		1900	2000	2120	0220	4 b, 6
Franklin Point[3]	26 Feb. 1961	1		1930	2000?	2120	0220	4 b, 6
Mopalia muscosa (Gould, 1846)								
Aquatic Park, San Francisco[2]	15 July 1961	1		1500?	1730	1530	2020	
Aquatic Park, San Francisco[2]	15 July 1961		1	1530?	1730	1530	2020	
Mopalia lignosa (Gould, 1846)								
North Side, San Pedro Point[3]	27 Feb. 1957		1	2300	2400	2235	0350	
North Side, San Pedro Point[3]	27 Feb. 1957		1	2400	2440?	2235	0350	
North Side, San Pedro Point[3]	27 Feb. 1957	1		9 b	9 b	2235	0350	7
Muir Beach[1]	12 Mar. 1957	1		2000	2100	2100	0220	4 a
Bolinas Point[1]	13 Mar. 1957		1	2000	2110	2145	0320	4 a
Placiphorella velata (Carpenter in Pilsbry, 1892)								
Mission Point[4]	28 Sep. 1959		1	2100?	2240	2315	0445	5

Table 2: Other Chiton Species

Location	Date	♀	♂	Gamete Shedding		Tide		Note
				Time Start	Time Finish	Next High	Next Low	
Ischnochiton radians (Carpenter in Pilsbry, 1892)								
North Side, San Pedro Point[3]	14 Feb. 1957	1?		9 c	9 c	2325	0455	7
North Side, San Pedro Point[3]	14 Feb. 1957		?	9 c	9 c	2325	0455	7, 10
Ischnochiton mertensi (Middendorff, 1846)								
Año Nuevo Bay[3]	13 Feb. 1957	1		2200?	2315	2215	0330	5
Ischnochiton regularis (Carpenter in Pilsbry, 1892)								
Mission Point[4]	21 Feb. 1960		5	2130	2400	1915	2345	8, 11
Ischnochiton californiensis Berry, 1931								
North Side, Resort Point[5]	26 Dec. 1956	1		9 d	9 d	1800	2235	7
North Side, Resort Point[5]	26 Dec. 1956		1?	9 d	9 d	1800	2235	7, 12
White's Point[5]	30 Dec. 1956		2?	2130?	2230	2130	0200	5, 8
Chaetopleura gemma (Carpenter in Pilsbry, 1892)								
Tomales Bay[1]	3 June 1961		2?	1530?	1615	1740	2240	5, 8
Tonicella lineata (Wood, 1815)								
North Side, San Pedro Point[3]	19 Apr. 1957		1	9 e	9 e	1600	2030	7

[1] = Marin County [2] = San Francisco County [3] = San Mateo County
[4] = Monterey County [5] = Los Angeles County

other occasions I have seen them move intermittently and, more rarely, move continuously throughout the entire time they are releasing sperm.

The ejection of eggs and sperm from the body cavity seems to be aided by rhythmic movements of the foot. This may explain why the females seem loosely attached to the substrate at the beginning of spawning.

Egg laying is a two-stage process. The eggs are first ejected into the mantle cavity where several hundred may accumulate on each side of the foot. The eggs are carried posteriorly, presumably by ciliary currents, and emerge through an upraised portion of the hindmost part of the girdle. Frequently, the eggs emerge as two "streams", one from each side of the mantle cavity. As they first emerge from the mantle cavity, the eggs are propelled at considerable speed but slow down almost immediately and seldom travel more than two to three centimeters. The eggs accumulate in a pile behind the female.

Initially, the sperm is discharged in spurts and has a coagulated appearance, as if enclosed in mucus. The sperm disperses very slowly at this stage. As the male continues to release sperm, the discharge becomes more continuous and the product no longer appears coagulated. Dispersion of the sperm at this time is more rapid. In all cases which I have observed, the male extends the lateral edges of his foot to cover the mantle cavity in the area of the genital opening. It has not been possible to determine whether the sperm accumulates in the mantle cavity of male chitons as the eggs do in the mantle cavities of the females.

I have gained the impression that once gamete release has begun, rather drastic conditions are required to cause the chiton to cease. A very strong light which gives off considerable heat will cause interruption of spawning, if the light is placed close to the chiton. On the other hand, I have removed both males and females, in the process of releasing gametes, from collecting jars and transferred them into dishes filled with sea water, where gamete release continued with little or no interruption. On other occasions, female chitons have fallen off the sides of a jar or dish in which they were spawning, been turned over (as they had landed foot uppermost), and resumed spawning without interruption. One male Mopalia ciliata (Sowerby, 1840) released sperm for over half an hour while partially curled upon his back. Finally, in an experiment, the water in a jar in which two male Ischnochiton (Lepidozona) californiensis were releasing sperm was violently agitated. The water was emptied, replaced, and once again violently agitated. The water was again emptied from the jar but this time was not replaced for a period of three minutes. When the jar was refilled, the chitons were almost immediately releasing sperm again, and I doubt if any interruption of sperm release had occurred.

Sexual Products

The eggs of Mopalia appear to be shed individually without any visible trace of an albuminous sheath or envelope. However, the eggs do not disperse in sea water as easily as one would expect. When eggs are fixed in formaldehyde and sea water soon after they have been shed, they seem to be enclosed in an amorphous, slightly translucent mass. Individual eggs can be removed from this enclosing mass only with difficulty. This mass enclosing the eggs is most noticeable with unfertilized eggs but gradually disappears or disperses 12 to 15 hours after fertilization. The exact nature of this "envelope" is unknown.

All chiton eggs I have seen are spherical in shape. Each egg is enclosed in its own individual egg case. Numerous spine-like or plate-like processes project from the surface of the egg cases, giving the cases the appearance of transparent, short-spined sea urchins. The projections of the egg cases of Ischnochiton radians (Carpenter in Pilsbry, 1893) are spine-like. Those of the egg cases of I. mertensi (Middendorff, 1846) are plate-like and may be either wavy or curled. The projections of the egg cases of the species of the genus Mopalia are intermediate, between those of I. radians and I. (L.) mertensi.

The eggs of the species of Mopalia, Nuttallina, Cyanoplax, Katharina, Cryptochiton, and Placiphorella are a light grey-green. Those of N. californica (Reeve, 1847) and M. lignosa (Gould, 1846) are a brighter green. The eggs of the species of the subgenera Lepidozona and Stenoplax of the genus Ischnochiton are pinkish or tawny-buff in color. Ischnochiton (S.) fallax (Carpenter in Pilsbry, 1892) is an exception among the Ischnochitons, the eggs of this species being green in color.

The average diameters of the unfertilized eggs of several species of chitons are listed in Table 3. Measurements were made on eggs preserved in formaldehyde and sea water and do not include the egg case.

Table 3:

Species	Diameter in microns
Mopalia porifera (Pilsbry, 1892)	170
Mopalia imporcata (Carpenter in Pilsbry, 1892)	180
Mopalia ciliata (Sowerby, 1840)	200
Mopalia spec. nov.	200
Mopalia lowei (Pilsbry, 1918)	200
Mopalia lignosa (Gould, 1846)	240
Ischnochiton mertensi (Middendorff, 1846)	200
Ischnochiton radians (Carpenter in Pilsbry, 1893)	180

Heath (1899) reports that the eggs of Ischnochiton (Stenoplax) magdalenensis (Hinds, 1844) [= I. (Stenoradsia) heathiana Berry, 1946] average about 400 microns in diameter. I find it curious that the eggs of various species of Mopalia are so much smaller than those of I. (S.) heathiana, when it is considered that the latter species has a free-swimming larval stage that lasts less than 5 percent as long as the free-swimming stage of Mopalia larvae. One would expect that the species with the longer free-swimming stage would require more stored food and therefore possess the larger eggs.

Larval Development

The development of Mopalia ciliata follows quite closely that of Lepidopleurus asellus (Spengler) as described by Christiansen (1954) and that of Chaetopleura apiculata (Say) as described by Grave (1932) in general pattern and the timing of development. The larval development of M. ciliata differs from that of Ischnochiton (Stenoradsia) heathiana as described by Heath (1899) in having more rapid initial cleavage after the egg is fertilized, in emerging from the egg case at a much earlier stage of development, and in possessing a much longer free-swimming larval stage. Table 4 summarizes some of the principal events in the larval development of M. ciliata in chronological order.

Discussion

All of the ten species considered in this paper which have laid eggs can be described as free spawning for, although as I have indicated in the case of Mopalia ciliata, some mucus is present, the eggs can be dispersed fairly easily in sea water. This would also seem to be the case for Ischnochiton (Lepidozona) cooperi (Carpenter in Pilsbry, 1892) as described by Heath (1905). Heath (1905) describes the eggs of Katharina tunicata (Wood, 1815) as being enclosed in a ?visible mucus secretion. According to Grave (1932), the eggs of Chaetopleura apiculata are also enclosed in a mucus secretion, and Christiansen (1954) describes a similar condition for the eggs of Lepidopleurus asellus. The greatest development of a mucus or albumen secretion surrounding the eggs occurs in I. (Stenoradsia) heathiana, where, according to Heath (1899), the eggs are enclosed in long albuminous sheaths, which are of sufficient strength to hold the eggs together for several days after spawning.

Both Nuttallina thomasi (Pilsbry, 1898) and Trachydermon (= Cyanoplax) raymondi (Pilsbry, 1894) do not release their eggs into the surrounding water but retain them in the mantle cavity until after the larvae have gone through metamorphosis (Heath, 1905). The latter species is unique in being the only one thus far described which is hermaphroditic (Heath, 1907).

I began to suspect rather early that there might be some correlation between the time that both sexes of Mopalia ciliata released gametes and the tidal cycle. Figure 1 shows the gamete release times for M. ciliata. The reference point for this species is the low high tide occurring after collection. Figure 3 shows the gamete release times for Mopalia spec. nov. (see Thorpe, 1961). The reference point for this species is the next high low tide following collection. Figure 2 represents the average spring tide tidal cycle since the times between the successive high and low tides do not remain constant throughout a month or a year, and the data cover a period of several years. The low high tide for the day was selected as the reference point, which introduces a maximum error of not more than 5 percent in the times shown between the low low tide and the low high tide and a maximum error of not more than 9 percent in the times shown between the low high tide and the high low tide. The gamete release times for each species are in the same order and represent the same individuals shown in Table 1, except that the last 15 individuals in Figure 1 and the last four individuals in Figure 3 represent recent observations which were not included in Table 1.

Although not perfect in detail, there seems to be a reasonably good correlation between the time that individuals of Mopalia ciliata release gametes and the low high tide for the day. Mopalia spec. nov. follows a different pattern. The females apparently spawn on a low tide, while the males show a less predictable pattern. The difference shown by the two species is of particular interest because they are believed to be very closely related.

Table 4:

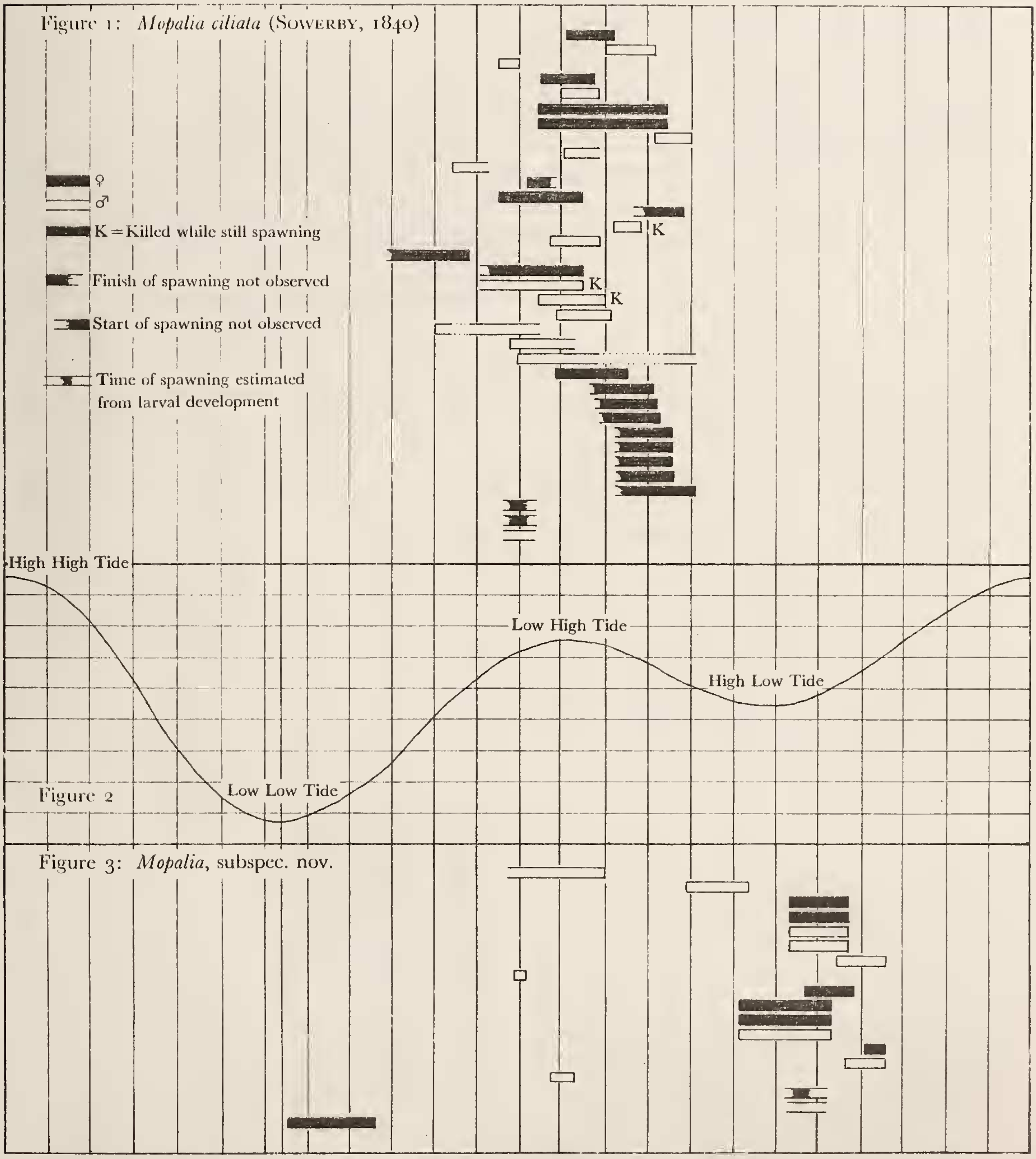
The development of *Mopalia ciliata* (Sowerby, 1840)

Time After Fertilization	Features of Development or Behavior Typical for the Time Period Shown
0 hours	Fertilization. Polar body minute and transparent.
1-1½ hours	First cleavage occurs.
2 hours	Second cleavage occurs.
3- 6 hours	Third and subsequent cleavages are somewhat more rapid in the micromeres. Macromeres tend to be slightly larger than micromeres.
10-12 hours	Gastrulation beginning. The first cilia of the velum are developed and beating at about 12 hours.
18-24 hours	Cilia of velum encircle larvae and beat in wave-like motions. Gastrulation apparently complete at 24 hours.
24-48 hours	Larvae emerge from egg cases during this period. Development to this stage temperature dependent, i. e., larvae developed at 12-15° C. above normal ocean temperature emerge from egg cases in 12 to 24 hours; those developed at 3-5° C. above normal emerge at 24 hours. Larvae developing at normal ocean temperature emerge in 36 to 42 hours. Apical cilia develop just prior to emergence from the egg case.
2- 4 days	Larvae are free swimming in aerated water; in non-aerated water they remain at the bottom and move only slightly. Photonegative. Larvae most active at the end of this period; swimming may be in a loose spiral, with the larvae rotating rapidly, or in a straight line without rotation.
4- 5 days	The anlagen of the ocelli and the valves begin to develop towards the end of the fourth day. The anterior valves are the first to be apparent. Larvae becoming elongated in the antero-posterior axis and flattened dorso-ventrally.
5- 8 days	Larvae noticeably less active. The predominant movement towards the end of this period is creeping. All eight valves and $CaCO_3$ spicules of the girdle present on the eighth day. End of free swimming stage.
8-16 days	"Metamorphosis" complete at 16 days where the larvae are not retarded by unfavorable conditions. The anus has developed. Ocelli still present. Valves are still covered by epithelium. Velum and apical cilia have been lost. Anlagen of the radula develop during this period. When examined under a microscope, the larvae attach to the slide by posterior portion of the foot, which portion in stained preparations has a glandular appearance.

Brewin (1942) has shown that Cryptoconchus porosus (Burrow, 1815) releases gametes every 15 days for a period of 2 to $2\frac{1}{2}$ months, and spawning is apparently correlated with the phases of the moon. Gamete release by C. porosus occurred regularly during the middle of the day and was not correlated with the tidal cycle. Brewin was also able to show that the results obtained in the laboratory coincided with the dates and times of gamete release by the animals in their natural habitat.

Christiansen (1954) and Heath (1905) have reported that egg laying in chitons occurs only after males have released sperm. Their statements were apparently based upon small numbers of observations. From experiments with Mopalia lignosa and Ischnochiton heathiana, Heath (1905) concluded that sperm or some hormonal product released by the male chiton was necessary if spawning was to occur.

On the other hand, Grave (1932) states that Chaetopleura apiculata females will spawn when isolated from the males. Brewin (1942) observed that females of Cryptoconchus porosus would spawn prior to sperm release by the males of the same species. In the first case Grave was working with a fairly large number of animals, while Brewin's observations were made over a prolonged period of time. The results obtained by Mr. Daryl Sweeney and myself are shown in Table 5.



each division = one hour

Table 5:

Species	Total	Females Spawning before males began to release sperm or when males did not release sperm	Females Spawning when isolated from the males for periods of 3 to 6 hours
Mopalia porifera (Pilsbry, 1892)	8	4	
Mopalia imporcata (Carpenter in Pilsbry, 1892)	3		3
Mopalia ciliata (Sowerby, 1840)	8	5	2
Mopalia spec. nov.	5	1	
Mopalia hindsi (Reeve, 1847)	2		2
Mopalia lowei (Pilsbry, 1918)	1		1
Mopalia lignosa (Gould, 1846)	2		1
Ischnochiton mertensi (Middendorff, 1846)	1	1	
Totals:	30	11	9

The ten females not accounted for in columns 3 and 4 are those which spawned after one or more males had released sperm

It seems to me that the evidence, although admittedly rather scanty, fails to support the hypothesis that the release of sperm is the immediate cause for spawning. The effects of sperm release, or the effect of some as yet undetermined male hormone upon the females over longer periods of time, is unknown.

Summary

Observations of gamete release by 14 species of California chitons are reported. Details of behavior during breeding and of the development of the larvae are given for Mopalia ciliata. Gamete release in this and one other species shows correlation with the tidal cycle.

Acknowledgment

I am most grateful to Mr. Daryl Sweeney for permission to use some of his data in this paper. They form an integral and important part thereof. My thanks also to Mr. Allyn G. Smith for his many helpful suggestions and encouragement.

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Notes & News

Busycotypus (B.) canaliculatus in San Francisco Bay

BY

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Although the channeled whelk has been found sporadically in San Francisco Bay presumably ever since 1938, it is only within recent years that it seems to have become relatively abundant, at least in certain localities. The first observation is attributed by Dr. Leo G. Hertlein of the California Academy of Sciences to an unnamed collector who is alleged to have obtained living specimens of this species while dredging for "oyster shell", a dietary supplement for chickens, in 1938. This report is quoted both in Puffer and Emerson (1954) and in Hollister (1958), from a personal communication by Dr. Hertlein. However, the earliest recorded specimens (three) in the collection of the California Academy were obtained by Rogers on December 20, 1950, "at about the foot of Gilman Street" in San Francisco (2 on map, textfig. 1). Four additional specimens in the same collection were obtained by C. H. Roof at Coyote Point (4 on map, textfig. 1) in San Mateo County, on March 27, 1954. In the collection of the Geology Department at Stanford University is a specimen which was dredged off Bay Farm Island (1 on map, textfig. 1), Alameda County, by P. J. Gambetta in February 1948. This seems to be the earliest record of the species in San Francisco Bay, as far as I have been able to ascertain. It seems logical to suggest, therefore, that the year 1938 is either a typographical error or an error of memory and that actually the year 1948 represents the first occurrence of the species. In the collection of the Department of Zoology at the University of California in Berkeley, there are additional records, as follows:

A young specimen from Point Bluff (3 on map, textfig. 1), Marin County, collected by Earl Barnawell on June 14, 1953.

A mature specimen snagged with a fishhook off Belmont Slough (5 on map, textfig. 1), San Mateo County, by H. A. Dalton on June 29, 1958.

A mature specimen brought in alive by Mr. Charles Barry, from Alameda (7 on map, textfig. 1), Alameda County, in May 1960.

While all the instances of observations recorded thus far concern only one or very few individuals, there are now available also observations on larger numbers of individuals. On December 22, 1958, Miss Laura Cantrel of Oakland collected 26 specimens at the foot of San Mateo Bridge (6 on map, textfig. 1), San Mateo County. During the year 1961 two members of the Northern California Malacozoological Club, Mrs. Wanda Martin of Albany and Mrs. Verna Wegner of El Cerrito, collected over 100 specimens, ranging from very small to apparently fully mature specimens, near Alameda (7 on map, textfig. 1) in Alameda County. These two collectors also picked up several strings of egg capsules. On November 16, 1961, Mrs. Martin brought two living whelks and one egg string to the Department of Zoology for exhibit in the hall aquaria. The string, about 22 inches long when gently extended (but still somewhat coiled) consists of 98 typical egg capsules. From these capsules about 40 to 50 young have emerged within the first two weeks in the aquarium.

Only one or two additional young specimens have been observed between December 1, 1961,

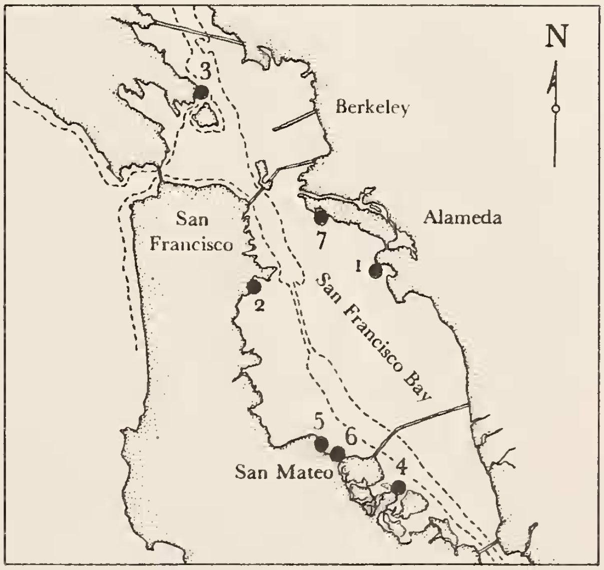

Figure 1

Map of the central and southern portions of San Francisco Bay, showing collecting stations of *Busycotypus (Busycotypus) canaliculatus* (LINNAEUS, 1758)
1: Bay Farm Island; 2: foot of Gilman Street, San Francisco; 3: Point Bluff; 4: Coyote Point; 5: Belmont Slough; 6: foot of San Mateo Bridge; 7: Alameda
(broken line is -28 foot contour)

and January 13, 1962.

Through the generosity and cooperation of Dr. Leo G. Hertlein, Dr. Myra Keen, Mrs. Martin, and Mrs. Cantrell, I have been able to measure a considerable sample of all specimens collected. In Table 1 I have summarized the results.

There are several interesting points to be observed from the map and the table. Busycotypus canaliculatus (Linnaeus, 1758) is reported from the east coast of the United States as occurring in shallow waters. Yet there are three distinct areas within San Francisco Bay where Busycotypus has been obtained, namely, the west shore and the east shore, respectively, of the southern portion of the Bay, and the west shore of the northern portion of the Bay. These three portions are separated from each other by relatively deep channels. The San Francisco Bay Pollution Investigation project under the direction of Mr. R. A. Wagner has carried out numerous dredgings in these channels, particularly in the southern portion, but no living or dead specimens of Busycotypus have been recovered (personal communication from Mr. Wagner). This poses a puzzle regarding the distribution of the species. Possibilities coming to mind are: separate introductions; accidental transport of egg strings or young specimens by logs floating across the Bay. Since the young are fairly large when they emerge from the egg capsule – i. e., about a quarter of an inch in greatest length – and are not free swimming, the disrupted distribution cannot be explained by the migration of a "free-swimming" larval stage.

Reports on Busycotypus from the east coast of the United States indicate a maximum length of 7½ inches. The largest specimen in Mrs. Martin's collection, measuring 185 mm., just about equals this maximum length. It seems interesting to note the more or less gradual increase in the maximum length observed over the years.

It is apparent that Busycotypus canaliculatus is to be regarded as well established in San Francisco Bay, and if our amateur collectors do not eradicate the species by over-collecting, this may prove a welcome addition to the Bay fauna. There are no common native shallow water species which equal Busycotypus in size, except Polinices lewisii (Gould, 1847). Therefore, Busycotypus may be most welcome as dissection material for the many classes in elementary zoology taught around San Francisco Bay.

Acknowledgment

The generous cooperation of Drs. Leo G. Hertlein and A. Myra Keen, who made the collections under their care available to me, and of Mrs. Wanda Martin and Miss Laura Cantrell is gratefully acknowledged.

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Table 1:

Measurements (in millimeters) of Specimens of *Busycotypus* (*Busycotypus*) *canaliculatus* (Linnaeus, 1758) from San Francisco Bay

Date	Collection	Number of Specimens	Smallest	Largest	Locality (sec Map)
1948 Feb.	Stanford University	1		96.6	Bay Farm Island
1950 Dec. 20	Cal. Acad. Sci.	3	64.4	102.0	San Francisco
1953 June 14	U. C. Zoology	1		36.8	Point Bluff
1954 Mar. 27	Cal. Acad. Sci.	4	105.1	161.8	Coyote Point
1958 June 29	U. C. Zoology	1		165.0	Belmont Slough
1958 Dec. 22	Cantrell	26	30.1	136.5	San Mateo Bridge
1960 May	U. C. Zoology	1		140.0	Alameda
1961	Martin	over 100	34.0	185.0	Alameda